



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Mr. Larry Lawson, Director
Division of Water Program Coordination
Virginia Department of Environmental Quality
629 Main Street
Richmond, VA 23219

Dear Mr. Lawson:

The Environmental Protection Agency (EPA) Region III is pleased to approve the Total Maximum Daily Load (TMDL) report for the primary contact use (bacteria) impairment on the South Mayo River. The TMDL report was submitted to EPA for review in January 2004. The TMDL was established and submitted in accordance with Section 303(d)(1)(c) and (2) of the Clean Water Act to address an impairment of water quality as identified in Virginia's 1998, Section 303(d) list.

In accordance with Federal regulations at 40 CFR §130.7, a TMDL must comply with the following requirements: (1) designed to attain and maintain the applicable water quality standards, (2) include a total allowable loading and as appropriate, wasteload allocations (WLAs) for point sources and load allocations for nonpoint sources, (3) consider the impacts of background pollutant contributions, (4) take critical stream conditions into account (the conditions when water quality is most likely to be violated), (5) consider seasonal variations, (6) include a margin of safety (which accounts for uncertainties in the relationship between pollutant loads and instream water quality), (7) consider reasonable assurance that the TMDL can be met, and (8) be subject to public participation. The enclosure to this letter describes how the TMDL for the primary contact use impairment satisfies each of these requirements.

Following the approval of the TMDL, Virginia shall incorporate the TMDL into the Water Quality Management Plan pursuant to 40 CFR § 130.7(d)(2). As you know, all new or revised National Pollutant Discharge Elimination System permits must be consistent with the TMDL WLA pursuant to 40 CFR §122.44 (d)(1)(vii)(B). Please submit all such permits to EPA for review as per EPA's letter dated October 1, 1998.



If you have any questions or comments concerning this letter, please don't hesitate to contact Mr. Thomas Henry at (215) 814-5752.

Sincerely,

Jon M. Capacasa, Director
Water Protection Division

Enclosure



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Decision Rationale

Total Maximum Daily Load for the Primary Contact Use (Bacteriological) Impairment on South Mayo River

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by a state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be discharged to a water quality-limited water body.

This document will set forth the Environmental Protection Agency's (EPA) rationale for approving the TMDL for the primary contact use (bacteriological) impairment on the South Mayo River. EPA's rationale is based on the determination that the TMDL meets the following eight regulatory conditions pursuant to 40 CFR §130.

- 1) The TMDL is designed to implement applicable water quality standards.
- 2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.
- 3) The TMDL considers the impacts of background pollutant contributions.
- 4) The TMDL considers critical environmental conditions.
- 5) The TMDL considers seasonal environmental variations.
- 6) The TMDL includes a margin of safety.
- 7) There is reasonable assurance that the TMDL can be met.
- 8) The TMDL has been subject to public participation.

II. Background

The South Mayo River Watershed is located in Patrick County, Virginia. The Watershed is 56,600-acres in size. The 5.77 mile impaired segment of South Mayo River begins at its confluence with Russell Creek and terminates at its confluence with Spoon Creek. South Mayo River is a rural watershed with approximately 75% of its land classified as forested. Agricultural (pasture) lands compose an additional 22% of the watershed, the remainder of the watershed consists of residential, crop, and wetlands.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental Quality (VADEQ) listed 5.77 miles of the South Mayo River (VAW-L43R) on Virginia's 1998 Section 303(d) list as being unable to attain its primary contact use due to violations of the bacteriological criteria. This

decision rationale will address the TMDL for the primary contact use impairment on the South Mayo River.

South Mayo River was listed for violations of Virginia's fecal coliform water quality criteria. Fecal coliform is a bacterium which can be found within the intestinal tract of all warm blooded animals. Therefore, fecal coliform can be found in the fecal wastes of all warm blooded animals. Fecal coliform in itself is not a pathogenic organism. However, fecal coliform indicates the presence of fecal wastes and the potential for the existence of other pathogenic bacteria. The higher concentrations of fecal coliform indicate the elevated likelihood of increased pathogenic organisms.

EPA has been encouraging the states to use e-coli and enterococci as the indicator species instead of fecal coliform. A better correlation has been drawn between the concentrations of e-coli and enterococci, and the incidence of gastrointestinal illness. The Commonwealth has adopted e-coli and enterococci criteria. Streams will be evaluated via the e-coli and enterococci criteria after 12 samples have been collected using these indicator species. The fecal coliform criteria will be used in the interim.

As Virginia designates all of its waters for primary contact, all waters must meet the current fecal coliform standard for primary contact. Virginia's standard applies to all streams designated for primary contact for all flows. The fecal coliform criteria was modified in 2002 to require that the fecal coliform concentration not exceed a geometric mean of 200 colony forming units (cfu) per 100 milliliters (mL) of water for two or more samples collected over a month nor shall more than 10% of the total samples exceed 400 cfu/100 mL of water. The new e-coli criteria requires a geometric mean concentration of 126 cfu/100mL of water with no sample exceeding 235 cfu/100 mL of water. Unlike the fecal coliform criteria which allows a 10% violation rate the new e-coli criteria requires the concentration of e-coli not exceed 235 cfu/ 100mL of water. Although, the TMDL and criteria require the 235 cfu/100 mL of water not to be exceeded waters are not placed on the Section 303(d) list if their violation rate does not exceed 10%.

The TMDLs submitted by Virginia are designed to determine the acceptable load of fecal coliform which can be delivered to the impaired waters, as demonstrated by the load-duration approach. The load-duration approach is considered an appropriate method to analyze the impaired water through its analysis and comparison of observed flows, in-stream bacteria concentrations, and the numeric water quality criteria.

The load-duration approach analyzes the stream's entire flow record to find a correlation between flow regimes and bacteriological concentrations. The load-duration approach uses flow data collected by a local gaging station, in this instance the United States Geological Survey (USGS) gage 02069700 was used for the TMDL development process. Conveniently, this was also the location of the VADEQ ambient water quality monitoring station. For each flow along the load-duration curve the allowable load can be determined by multiplying the numeric criteria by the flow. The observed loads

were determined by multiplying the observed concentrations by the flow that was observed at that time. In order to insure that the TMDL was protective of all flow conditions, it was developed to the instance when the difference between the observed and allowable loadings was greatest. In order to convert the fecal coliform loads to e-coli (the new indicator species), a translator equation was used. This process describes the first step in the development of the TMDL.

The next step of the TMDL was to determine what organisms or sources are responsible for the pollutant loading to the stream. Since fecal coliform is associated with warm blooded animals as mentioned above, it was necessary to determine which animals were providing the bacteria loadings to the South Mayo River. Through a process known as bacterial source tracking (BST), VADEQ was able to breakdown the source of bacteria into four categories. The four categories were human, pets, livestock, and wildlife. Three of these four sources are anthropogenic in origin and can be controlled via a variety of techniques. Wildlife, which may be attracted to certain areas due to anthropogenic reasons is considered a natural source of bacteria.

The BST approach used by VADEQ is known as the Antibiotic Resistance Approach (ARA) which measures the bacteria's resistance to a suite of antibiotics. The assumption is that bacteria associated with humans will have the highest resistance to antibiotics due to previous exposures to antibiotics. Livestock and pets would have the next highest resistance, while wildlife would exhibit the least resistance. In order to conduct this work waste, samples from known sources had to have their resistance measured, this information was placed into a library. The resistance of the bacteria collected in water samples was compared to the data in the library to determine its source. For additional information of the ARA please refer to Appendix B of the TMDL.

The data collected in steps one and two were then combined to determine the impact of the sources to water quality in South Mayo River. VADEQ collected one year of BST samples from the water, for each sample VADEQ determined the bacterial concentration and the percent loading derived from each source. This percent loading for each source category was averaged over the annual period and this average percent loading was used to determine the loading for each source. In the South Mayo River TMDL, the highest bacteria violation occurred during a flow of 77 cubic feet per second (cfs). The translated e-coli load for this flow event was $8.94\text{E}+15$ cfu/ year. The allowable load at this same flow was $1.62\text{E}+14$ cfu/year. This represents a 98% reduction in loadings. The BST data demonstrated that livestock, pets, humans, and wildlife represented 34, 29, 18, and 18 percent of the load respectively. Therefore, it was determined that all sources must be reduced.

Through the development of this and other similar TMDLs, it was discovered that natural conditions (wildlife contributions to the streams) could cause or contribute to violations of the bacteria criteria. BST sampling data collected on the South Mayo River indicated that bacteria from wildlife represents 18 percent of the load. Many of Virginia's TMDLs, including the TMDL for the South Mayo River, have called for some reduction in the amount of wildlife

contributions to the affected streams. EPA believes that a significant reduction in wildlife is not practical and will not be necessary due to the implementation plan discussed below.

A phased implementation plan will be developed for all streams in which the TMDL calls for reductions in wildlife. In Phase 1 of the implementation, the Commonwealth will begin implementing the reductions (other than wildlife) called for in the TMDL. In Phase 2, which can occur concurrently to Phase 1, the Commonwealth will consider addressing its standards to accommodate this natural loading condition. The Commonwealth has indicated that during Phase 2, it may develop a Use Attainability Analysis (UAA) for streams with wildlife reductions which are not used for frequent bathing. Depending upon the result of the UAA, it is possible that these streams could be designated for secondary contact.

After the completion of Phase 1 of the implementation plan, the Commonwealth will monitor the stream to determine if the wildlife reductions are actually necessary, as the violation level associated with the wildlife loading may be smaller than the percent error of the model. In Phase 3, the Commonwealth will investigate the sampling data to determine if further load reductions are needed in order for these waters to attain standards. If the load reductions and/or the new application of standards allow the stream to attain standards, then no additional work is warranted. However, if standards are still not being attained after the implementation of Phases 1 and 2, further work and reductions will be warranted. It should be noted that VADEQ averaged the percent loads associated with each BST sample, which removed the magnitude of loading from the source analysis. This method increased the weight of the wildlife loading. If the average annual loading for each source was determined by dividing the average concentrations from each source over the sampling period by the average total concentration, wildlife would make-up less than 5% of the load. VADEQ will be evaluating the differences between the two source assessment methods.

Table 1 - Summarizes the Specific Elements of the TMDLs.

Segment	Parameter	TMDL (cfu/yr)	WLA (cfu/yr)	LA (cfu/yr)	MOS
Abrams Creek	E-Coli	2.65E+14	1.04E+12	2.59E+14	Implicit

The United States Fish and Wildlife Service has been provided with copy of this TMDL.

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing a primary contact (bacteriological) impairment TMDL for the South Mayo River. EPA is therefore approving this TMDL. EPA's approval is outlined according to the regulatory requirements listed below.

1) The TMDL is designed to meet the applicable water quality standards.

Virginia has indicated that excessive levels of bacteria from both anthropogenic and natural sources have caused violations of the water quality criteria and designated uses in the South Mayo River Watershed. The water quality criterion for fecal coliform was a geometric mean 200 cfu/100mL or an instantaneous standard of no more than 1,000 cfu/100ml. Two or more samples over a 30 day period are required for the geometric mean standard. Since the state rarely collects more than one sample over a thirty-day period, most of the samples were measured against the instantaneous standard. The Commonwealth has changed its bacteriological criteria as indicated above. The new criteria require that the fecal coliform concentration not exceed a geometric mean of 200 cfu per 100 milliliters of water for two or more samples collected over a month nor shall more than 10% of the total samples exceed 400 cfu/100 ml of water. The new e-coli criteria requires a geometric mean of 126 cfu/100mL of water with no sample exceeding 235 cfu/100 ml.

The load-duration approach, described above was used by the Commonwealth for the development of the South Mayo River TMDL. This approach uses the flow data from a USGS gage, in-stream water quality data, and BST data to quantify the bacteria loading and the sources responsible for that loading. The load-duration approach analyzes the stream's entire flow record to find a correlation between flow regimes and bacteriological concentrations. For each flow along the load-duration curve the allowable load can be determined by multiplying the numeric criteria by the flow. The observed loads were determined by multiplying the observed concentrations by the flow that was observed at that time. In order to insure that the TMDL was protective of all flow conditions, it was developed for the flow that exhibited the greatest difference between the observed and allowable loadings.

Through the use of BST, VADEQ was able to breakdown the source of bacteria into four categories. The four categories of bacteria sources were human, pets, livestock, and wildlife. Three of these four sources are anthropogenic in origin and can be controlled via a variety of techniques. Wildlife, which may be attracted to certain areas due to anthropogenic reasons is considered a natural source of bacteria.

VADEQ collected one year of BST samples from the water. VADEQ determined the bacterial concentration and the percent loading derived from each source for each sample. The percent loading for each source category was averaged over the annual period. This average percent loading was used to determine the loading for each source. In the South Mayo River TMDL, water quality samples associated with a flow of 77 cfs exhibited the greatest disparity between observed and allowable loads. The translated e-coli load for this flow event was 8.94×10^{15} cfu/ year. The allowable load at this same flow was 1.62×10^{14} cfu/year. This represents a 98% reduction in loadings. The BST data demonstrated that livestock, pets, humans, and wildlife represented 34, 29, 18, and 18 percent of the load respectively. Therefore, it was determined that all sources must be reduced.

2) *The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.*

Total Allowable Loads

Virginia indicates that the total allowable loading is the sum of the loads allocated to land based precipitation driven nonpoint source areas (forest and agricultural land segments) and point sources. Activities that increase the levels of bacteria to the land surface or their availability to runoff are considered flux sources. The actual value for total loading can be found in Table 1 of this document. The total allowable load is calculated on an annual basis.

Waste Load Allocations

There is one point source of bacteria to the South Mayo River. The Stuart Sewage Treatment Plant (STP) discharges treated waste water to the South Mayo River. The facility is permitted to discharge 600,000 gallons of treated effluent per day. The permit calls for the effluent to discharge bacteria at the numeric criteria. Therefore, the annual load can be determined by multiplying the flow by the numeric criteria. By discharging at criteria, the STP will not be able to cause a violation of the water quality criteria. However, its effluent will not be able to increase the assimilative capacity of the water. Often STPs, like Stuart STP discharge at rates and concentrations below what is called for in the permit. Therefore, it is likely that the waste load allocation (WLA) is over inflated as Stuart STP's average daily flow since February 1999 has been from 256,000 to 485,000 gallons per day.

EPA regulations require that an approvable TMDL include individual WLAs for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR 130.7." Furthermore, EPA has authority to object to the issuance of any National Pollutant Discharge Elimination System (NPDES) permit that is inconsistent with the WLAs established for that point source.

Table 2 - Bacteriological (E-Coli) WLAs for the South Mayo River

Facility Name	Permit Number	Existing Load (cfu/yr)	Allocated Load (cfu/yr)
Stuart STP	VA0022985	1.04E+12	1.04E+12

Load Allocations

According to Federal regulations at 40 CFR 130.2(g), load allocations (LAs) are best

estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint source loads should be distinguished.

The load-duration approach used BST data to determine the bacteria load from each source. According to the BST data livestock, pets, humans, and wildlife were responsible for 34, 29, 18 and 18 percent of the load respectively. Table 3 documents the bacteria loading by source category.

Table 3 - LA for Bacteria (fecal coliform) for South Mayo River

Source Category	Existing Load (cfu/yr)	Proposed Load (cfu/yr)	Percent Reduction
Livestock	5.03E+15	9.08E+13	98
Pets	4.21E+15	7.61E+13	98
Human	2.68E+15	4.84E+13	98
Wildlife	2.69E+15	4.86E+13	98

3) The TMDL considers the impacts of background pollution.

The TMDL considers the impact of background pollutants by considering the bacterial load from natural sources such as wildlife.

4) The TMDL considers critical environmental conditions.

According to EPA's regulation 40 CFR 130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of the impaired creeks is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards¹. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. This was addressed in the South Mayo River TMDL by modeling the reductions to

¹EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

the flow that exhibited the greatest disparity between observed and allowable concentrations.

5) The TMDL considers seasonal environmental variations.

Seasonal variations involve changes in stream flow and loadings as a result of hydrologic and climatological patterns. The loadings to the South Mayo River were investigated on a monthly basis to determine if seasonality existed between the sources. Based on the BST results it was determined that there was minimal seasonal impacts to loading and the source loads were averaged on an annual basis.

6) The TMDL includes a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. The MOS may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL. Virginia included an implicit MOS in the TMDL through the use of conservative modeling assumptions. The South Mayo River was modeled to the single-most extreme water quality violation event and applied the reductions necessary during that event to all conditions.

7) There is a reasonable assurance that the TMDL can be met.

EPA requires that there be a reasonable assurance that the TMDL can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program.

The TMDL is designed to meet the applicable water quality standards. The Commonwealth intends to implement the TMDL through best management practices (BMPs). The implementation of these practices will occur in stages. This will allow the Commonwealth to monitor the benefits of the BMPs and determine which practices have the greatest impacts on water quality.

8) The TMDL has been subject to public participation.

The TMDL was subject to the Commonwealth's public participation process. The meeting and comment period for this TMDL was public noticed in the Virginia Register. There was a public meeting

held on November 19, 2003 in Stuart, VA. Twelve people attended the public meeting. There were no comments sent to the VADEQ during the thirty-day comment period.